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ABSTRACT

This study compared instructional methods using interactive video in order to test the prototype model of concept acquisition and to assess the kinds of prototypes that learners develop. The subjects were 30 graduate students at two universities, who were randomly assigned to one of three treatment groups and completed an interactive video program on styles of art. The coordinate concept lesson featured the Baroque and Renaissance and Impressionistic and Post-Impressionistic styles as close-in/non-example sets, with each pair providing far-out non-examples for the other. The three treatments followed a pretest and presentation of the text to introduce the coordinate concept of styles of art: (1) prototype only, providing only the concept knowledge development phase of concept acquisition; (2) prototype plus practice, providing for the development of conceptual knowledge plus procedural knowledge; and (3) prototype plus elaboration plus practice, providing for development plus elaboration of conceptual knowledge plus procedural knowledge. Although a significant difference was found between the prototype only (control group) and the other treatments, no significant difference was found between the prototype plus practice and prototype plus elaboration plus practice treatments. A comparison of retention scores was not possible due to a problem with the computer program, but it is suggested that the elaboration strategy might well stimulate more resistant performance. (EW)

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PROTOTYPE DEVELOPMENT AND ACQUISITION IN AN INTERACTIVE VIDEO CONCEPT LESSON

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Introduction

Problem

Videodiscs are most commonly produced in the form of generic discs, ie. generic collections of still and motion video to support instruction in a field of study. The best instructional application of generic discs is as instance pools for concept lessons. Concept lessons depend upon a large, diverse collection of examples to provide enough of the matched, divergent example sets needed for concept teaching (Merrill & Tennyson, 1977). The thousands of images available on most generic discs (eg. the BioScience or National Gallery of Art videodiscs) make them ideal instance pools. What is needed in order to facilitate the use of generic discs as instance pools are good lesson templates for helping experienced and especially inexperienced designers to develop these concept lessons.

Concept Lesson Template

A useful template must be based upon good instructional design theory. Many models of concept formation are available (Millward, 1980). Probably the most popular among instructional designers is the Rule-Recall-Example-Practice presentation of concept definitions based upon exposition of the critical and variable attribute dimensions (Merrill & Tennyson, 1977). Problems often occur in applying this model to "real world" concepts, so Tennyson and Cocchiarella (1986) have provided an empirically based instructional design theory for concept instruction that is useful for developing a template. Their theory asserts that conceptual knowledge does not result from the memorization and application of defining criteria, but rather concepts are coded into memory as prototypes. Prototypes are abstractions of typical class members. Procedural knowledge of concepts is formed, as in expository instruction, by practice and feedback. In order to verify the prototype theory, Tennyson and others (1983) compared the formation of prototypes generated from seeing prototypic examples with classification from a list of defining attributes. In the prototype group, third graders compared each instance in the set with a prototype or "best example" of the concept, while the students in the attribute-list groups evaluated each instance for the presence of critical attributes. On immediate and delayed classification tests, the protoype groups outperformed the attribute groups.

Park (1984) corroborated these results when he compared an expository attribute isolation strategy (AIS) with a more generative example comparison strategy (ECS). The AIS group of twelfth graders used a list of attributes while classifying interrogatory instances. The ECS group compared a best example with each of the interrogatory instances while classifying them. In the ECS group, learners elaborated their own prototypes as decision criteria in classification tasks, while the AIS group used an externally-provided set of analytic attributes. The AIS learners classified more accurately during the instructional

program, but their classification ability decreased significantly on the retention test. That the ECS group retained their ability longer indicated that their elaborations produced a more durable conceptual knowledge.

The AIS and ECS templates were compared in a videodisc-based concept lesson (Jonassen, 1986) which found no difference in concept acquisition or retention. The prototype treatment compared each new instance with a set of three best examples while the attribute identification treatment presented the list of critical attributes. In order to distinguish empirically between conceptual knowledge and procedural knowledge, it is neccessary to compare the effects of prototype development with and without practice.

Another instructional strategy that would likely improve the development of prototypes (conceptual knowledge) is an elebaoration learning strategy that forces learners to articulate their own prototypes. Jonassen (1985) promoted the inclusion of learning strategies in courseware to deepen the level of processing by learners. Previous prototype research (Park, 1984) compared prototype development with checkoff of an attribute list which was not a generative activity. What if learners generated their own attribute list for each concept? Such a strategy should produce deeper processing which should positively affect the development of conceptual knowledge.

Purpose of Study

The prototype model of concept acquisition is gaining general acceptance. What is not clear in that model is the role of conceptual knowledge and procedural knowledge in the prototype model. Tennyson et al (1981) showed that adding practice with new instances to expository instruction improved classification ability. In this study, we compare protoype instruction with prototype + interrogatory instances (practice). In order to assess the kinds of prototypes that learners develop, a third learning strategy treatment was added. In this study, we ask learners to use a combination of imagery and paraphrasing strategies to elaborate the prototype they develop.

METHOD

Participants

Thirty volunteer graduate students in education programs at two universities were randomly assigned to one of three treatment groups and completed the study.

Instructional Materials

Three treatments of an interactive video lesson on "Styles of Art" comprised this coordinate concept lesson, featuring the Rennaissance, Baroque, Impressionistic and Post-Impressionistic styles of art. Baroque and Renaissance and Impressionistic and Post-Impressionistic are close-in example/non-example sets, while each pair are far-out non-examples for the other (Merrill & Tennyson, 1977). Close-in non-examples are more difficult to

discriminate from one another, resulting in a tendency to overgeneralize. The pretest, posttest, retention test, and instance pool required a rational set of 25 instances of each style of art. The set of examples came from the National Gallery of Art disc, which consists of a motion tour and art lesson and 3300 stills of 1400 works of art in the collection. The computer program is written for an Apple IIe driving a Pioneer LD-V2000 player through an Allen VMI interface card.

Treatments

All treatments included a 15-item pretest and posttest consisting of randomly sequenced sets of three examples of each style plus three distractors. Following the pretest, text was used to introduce the coordinate concept of styles of art. The treatments were presented next, followed by the posstest.

The prototype only presentation, providing only the concept knowledge development phase of concept acquisition, consisted of:
1) For each style of art, the name of the style was followed by three best examples (archetypical examples of that style). Participants were instructed to try to develop their own definition of the style.
2) A rational set of 16 was presented as examples. After each 10 second presentation, one best example of each style was presented. The participant decided which of the four best examples most closely resembled the example in terms of style. Knowledge of results was provided after each example.

The prototype + practice presentation, providing for the development of conceptual knowledge plus procedural knowledge, consisted of :
1) same as the previous treatment, plus
2) Ten additional practice items without prompting, followed by knowledge of results.

The prototype + elaboration + practice presentation, providing for development plus elaboration of conceptual knowledge plus procedural knowledge, consisted of:
1) the same treatment as in the prototype + practice, plus
2) After each set of best examples was presented, the screen was blanked and the participant was asked to close their eyes and form a mental image of that style of painting and then to type into the computer at least three characteristics of that style of painting. This imagery/paraphrasing strategy should improve conceptual development and improve practice and posttest classification accuracy.

Measurement

The dependent variables included posttest and retention test classification accuracy. The retention test was taken individually using the same configuration as in the treatment. The retention test, like the pretest and posttest, consisted of 15 items (3 of each style + 3 distractors).

Results and Discussion

The pretest scores for each of the groups (see Table 1 for group means) were not significantly different, $F(2)=2.06$, $p>.05$. Posttest scores, however, were significantly different, $F(2)=6.06, p<.01$. A Fisher's Least Significant Difference Test showed that the prototype only (control) group scores differed significantly from both of the other treatment groups. However, the prototype+practice and prototype+practice+elaboration groups were not significantly different. A bug in the computer program which drives the video player prevented the correlation of retention test data to the other scores as well as eliminating several student scores, so only the immediate posttest data for 30 subjects was available for analysis.

In order to factor prior knowledge of the subject matter, we conducted a repeated measures (group by pretest/posttest) analysis of variance. The analysis showed significant main effects for the repeated measure, $F(1)=62.36, p<.001$. It is obvious from the mean pretest and posttest scores that learning did take place. The main effect for group approached significance, $F(2)=2.63, p=.08$. The univariate analysis showed that the practice and practice+elaboration groups differed significantly from the control group on the posttest but did not differ between them. The change score (posttest-pretest) was higher for the practice+elaboration group (M=5.5) than for the practice group (M=3.8).

The prototype treatments obviously produced learning during the lesson. Practice has consistently been shown to improve concept learning (Tennyson et al, 1981). Virtually all of the mathemagenic literature supports that conclusion as well. Of greatest interest to this study was the effect of performing the elaboration strategy. This type of strategy forces learners into deeper processing. The results indicated a trend in favor of the elaboration strategy group. The loss of several subjects in the analysis probablistically affected those results. We will run additional subjects this winter and reanalyze the data.

The major unknown from this study is the effect of different treatments on retention scores. Previous research (Jonassen, 1986; Park, 1984) has shown that the prototype concept acquisition strategy is less susceptible to decay on retention tests. The elaboration strategy, if it in fact stimulates deeper processing, should produce even more resistant performance. Long term retention is normally positively affected by deeper processing. Additional subjects should clarify this and other remaining questions.

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Table 1

Group Means

	Prototype Only	Prototype + Practice	Prototype + Practice + Elaboration
Pretest	6.9 (2.3)	7.6 (1.9)	5.6 (2.6)
Posttest	8.7 (2.3)	11.4 (1.8)	11.1 (1.4)